REMARKS

Claims 2-7 are pending in the application. Claim 2 has been amended.

In the Office Action, claims 2, 3, 6 and 7 were rejected under 35 U.S.C. §103(a) as being unpatentable over U.S. Patent 5,218,352 (Endoh) in view of U.S. Patent 4,196,432 (Chihara). Claims 4 and 5 were rejected under 35 U.S.C. §103(a) as being unpatentable over Endoh and Chihara and further in view of U.S. Patent 5,515,074 (Yamamoto). These rejections are respectfully traversed. Applicants respectfully request reconsideration and allowance of the claims in view of the following arguments.

Regarding the obviousness rejection of independent claim 2 based on Endoh and Chihara, neither of the cited references discloses or suggests the recited dormancy determining means for selecting within a single frame period at least one predetermined dormant period T0 during which the resulting voltage difference between all the common and segment terminals is zero, and it would not have been obvious to combine Endoh and Chihara to yield a device having the claimed dormancy means.

By way of background, it should be noted that Endoh (like the LCD drive of the present invention) is of the passive matrix type, wherein common and segment terminals; i.e., rows and columns, provide pixels at their crossings. In the matrix, many pixels (as many pixels as segment terminals) are arranged and connected to a single conductor for each common terminal, and are kept at the same potential. The matrix pattern is printed on a piece of glass to provide an LCD. The associated driver circuit is structurally simple and inexpensive. Passive matrix type LCDs, therefore, have been widely used. Disadvantageously, the number of common terminals in a passive matrix type LCD is limited, and accordingly the number of pixels is limited.

In contrast, the LCD of Chihara is of the electric field type, such as used in televisions and personal computers, which uses an active matrix whose pixels comprise independently controllable transistor switches. A transistor switch is required for each pixel formed on the surface of the glass. The associated driver circuit is structurally complex, and is therefore expensive. Advantageously, an active matrix LCD can have a very large number of pixels, and is capable of improving contrast.

As is apparent from the above discussion, different LCD drive circuits are used in passive matrices and active matrices. The present invention relates to an LCD driver for driving a passive matrix. Independent claim 2 has been amended for clarity to recite that the claimed invention is a passive matrix type LCD display device. This amendment is supported, for example, at Figs. 5-7 of the present application illustrating a passive matrix LCD drive circuit, and waveforms of the LCD drive voltage, respectively, and by the relevant description of Figs. 5-7 at page 4, line 11 et seq. of the application. The claimed LCD comprising a passive matrix and simple logic is advantageous in that it provides performance comparable to the field effect type LCD using an active matrix, as will be explained hereinbelow.

It is admitted in the Office Action that Endoh does not disclose the claimed dormancy determining means for selecting within a single frame period at least one predetermined dormant period T0 during which the resulting voltage difference between all the common and segment terminals is zero. However, it is contended that Chihara teaches such circuitry, and that it would have been obvious to include it in the display of Endoh to yield the invention of claim 2.

Applicant disagrees. The potential difference (i.e., the voltage) between the common and segment terminals for each pixel can be zero in Chihara's active matrix of the electric field type LCD, as pointed out in the Office Action. This is not true, however, for an LCD using a passive

matrix, such as the LCD of the present invention. In a passive matrix LCD, the potential difference between the common and segment terminals of a given pixel can be zero, but if a different wave form appears on another common terminal, the given pixel is influenced to cause a significant voltage difference between the common and segment terminals of the given pixel. Thus, it is impossible for the voltage of a selected pixel or pixels to be independently zero in a passive matrix LCD. The voltage of a selected pixel or pixels cannot be zero without influencing the other pixels of the same segment terminal, and hence the local density. Claim 2 has been amended for clarity to recite that the dormancy determining means selects, within a single frame period, at least one predetermined dormant period T0 during which the resulting voltage difference between all the common and segment terminals is zero. This amendment is supported, for example, at page 3, lines 10 to 14 of the application.

If Endoh were combined with Chihara, the resultant device would be capable of controlling all pixels in terms of their transistor switches so that the null potential condition or the display may be selectively given on the screen, which is exactly the function of an active matrix rather than that of a passive matrix, as claimed. Chihara, particularly Fig. 3, shows the use of a single common terminal, providing the state of non-lighting at zero voltage, the state of being turned off (tc) and the state of being turned on (ta; tb). The common terminal is one, and therefore there can be no frame period, as claimed. Thus, if Chihara were to be combined with Endoh, it would not result in the claimed controller for interleaving each frame period with zero potential periods.

No combination of Endoh and Chihara could render amended independent claim 2 obvious, because neither of the cited references discloses or suggests the recited passive matrix LCD display having a dormancy determining means for selecting within a single frame period at

least one predetermined dormant period T0 during which the resulting voltage difference between all the common and segment terminals is zero, and it would not have been obvious to combine Endoh and Chihara to yield a passive matrix LCD display device having the claimed dormancy means.

Consequently, independent claim 2 is patentable, as are claims 3, 6, and 7, which depend from claim 2.

Regarding the obviousness rejection of claims 4 and 5 based on Endoh, Chihara and Yamamoto, the Yamamoto reference discloses a device responsive to the surrounding temperature for controlling the density of displayed pictures. In particular, D/A converter 12 of Yamamoto's Fig. 1 is used to control the display in terms of drive voltage. Like Yamamoto, Endoh teaches that its display is controlled in terms of drive voltage. As shown in Fig. 6 of Endoh, switches are used to select the desired resistance R' or zero ohms (turning on) for providing drive voltage.

Controlling drive voltage is the conventional way of controlling LCD density. In contrast, the claimed invention does not change the drive voltage, but provides one frame period with a plurality of dormant periods for which zero voltage appears at each pixel. This can be achieved with recourse to a simple logic function, providing the equivalent of effecting a stepwise change in the drive voltage at lower cost.

Yamamoto's D/A converter 12 is an analog circuit, which would be costly it if were included on the same chip as an associated control circuit, which is a digital circuit. Furthermore, if the analog circuit is separate (i.e., not included in the same chip), not only would the unit be costly, but extra control terminals would be required, and accordingly the circuit would be increased both in size and complexity. Likewise, Endoh's switches require extra

terminals allotted for switching elements. The claimed invention enables all lines to participate in presentation of an image on the screen, not by controlling the drive voltage, but by causing the equivalent effect of making a stepwise change of drive voltage by interleaving one frame period with a plurality of dormant periods for which zero voltage appears at each pixel.

Thus, the Yamamoto reference does not furnish the dormancy determining means of independent claim 2, from which claims 4 and 5 depend. Therefore, no combination of Endoh, Chihara and Yamamoto, however made, would yield the invention of independent claim 2, and it would not have been obvious to modify any Endoh/ChiharaYamamoto combination to yield the invention of claim 2.

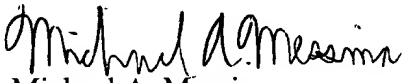
Reconsideration and withdrawal of the rejection of claims 2-7 under 35 U.S.C. §103(a) are respectfully requested.

Accordingly, it is believed that all pending claims are now in condition for allowance. Applicant therefore respectfully requests an early and favorable reconsideration and allowance of this application. If there are any outstanding issues which might be resolved by an interview or an Examiner's amendment, the Examiner is invited to call Applicant's representative at the telephone number shown below.

To the extent necessary, a petition for an extension of time under 37 C.F.R. 1.136 is hereby made. Please charge any shortage in fees due in connection with the filing of this paper, including extension of time fees, to Deposit Account 500417 and please credit any excess fees to such deposit account.

Respectfully submitted,

MCDERMOTT, WILL & EMERY



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